$\int_a^b v(t)\,dt =$ displacement

final position = initial position + displacement

$f(b) = f(a) + \underbrace{\int_a^b f'(x)\,dx}_{f(b)-f(a)}$

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Review 15 Euler's method
L'hopital's Rule

Euler's Method

x	y	y'
x_0	y_0	
x_1		
x_2		
$\vdots$		
x_f		

Δx Δx

$$\boxed{y_{n+1} = y_n + y' \cdot \Delta x}$$

find $y(x_f)$

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$y' = x + y$ $(1,4)$ stepsize $= .25$

$y(2) = ?$

x	y	y'
1	4	5
1.25	5.25	6.5
1.5	6.875	8.375
1.75	8.96875	10.713
2		

$4 + 5(.25) = 5.25$

$5.25 + 6.5(.25) = 6.875$

$6.875 + 8.375(.25) = 8.96875$

$8.96875 + 10.713(.25) \approx 11.648$

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L'Hopital's Rule

If $\lim_{x\to a} \frac{f(x)}{g(x)} = \frac{0}{0}$ or $\frac{\infty}{\infty}$

Then $\lim_{x\to a} \frac{f(x)}{g(x)} = \lim_{x\to a} \frac{f'(x)}{g'(x)}$

other indeterminate forms

$0^0, \infty^0, 0\cdot\infty, 1^\infty$

convert to $\frac{0}{0}$ or $\frac{\infty}{\infty}$

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$$\lim_{x\to 0} \frac{\sin x}{x^2}$$

$$\lim_{x\to 0} \frac{\cos x}{2x} \quad \begin{matrix}\nearrow 1 \\ \searrow 0\end{matrix}$$

$$= \infty$$

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$$\lim_{x\to\infty} x \sin\frac{1}{x}$$

$$\infty \cdot 0$$

$$\lim_{x\to\infty} \frac{\sin\frac{1}{x}}{\frac{1}{x}}$$

$$\frac{0}{0}$$

$$\lim_{x\to\infty} \frac{\cos\frac{1}{x}\cancel{\left(-\frac{1}{x^2}\right)}}{\cancel{-\frac{1}{x^2}}} = \cos 0 = 1$$

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$$\lim_{n\to\infty}\left(1+\frac{5}{n}\right)^n = y$$

$$\lim_{n\to\infty}\ln\left(1+\frac{5}{n}\right)^n = \ln y$$

$$\lim_{n\to\infty} n\ln\left(1+\frac{5}{n}\right) = \ln y$$

$$\lim_{n\to\infty}\frac{\ln\left(1+\frac{5}{n}\right)}{\frac{1}{n}} = \ln y$$

$$\frac{0}{0} \qquad \lim_{n\to\infty}\frac{\frac{1}{1+\frac{5}{n}}\cdot -\frac{5}{n^2}}{-\frac{1}{n^2}}$$

$$\lim_{n\to\infty}\frac{5}{1+\frac{5}{n}}$$

$$5 = \ln y$$

$$y = e^5$$

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$$\boxed{\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e}$$

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